In the Title:

Cancel the existing title and substitute therefor -- METHOD OF AUTOMATED COOLANT DELIVERY FOR A MACHINE TOOL --.

In the Cross-Reference to Related Application:

This application claims the benefit of Provisional Serial No. 60/282,541, filed 9 April, 2001 for AN AUTOMATED COOLANT DELIVERY SYSTEM FOR A MACHINE TOOL, by Gary Lee Curtis. This application is a divisional of patent application Serial No. 10/118,678, filed 9 April, 2002 for AUTOMATED COOLANT DELIVERY METHOD AND SYSTEM FOR A MACHINE TOOL by Gary Lee Curtis, and incorporated by reference herein.

In the Specification:

Page 7, line 2 through Page 8, line 8:

In accordance with the present invention, in a coolant delivery apparatus for a machine tool in which each of a plurality of cutting tools are movable into cutting position with respect to a workpiece, the improvement comprising a source of coolant, a nozzle having a coolant inlet connected to the source, the nozzle being pivotally mounted in facing relation to each of the cutting

tools when each one is advanced into cutting position so that the coolant stream is discharged from the nozzle to intersect a portion of the tool, and a mechanical actuator is provided to automatically adjust the angle of attack of the nozzle and its coolant stream with respect to each selected tool advanced into cutting position and in most cases to cause the coolant stream to intersect the interface between that tool and the workpiece. Preferably, the mechanical actuator is defined by a plunger assembly movable with the vertically movable head of the machine tool into engagement with a stop, and drive means is provided on the plunger for imparting pivotal movement to the nozzle a predetermined distance necessary to cause the coolant stream to intersect the cutting tool as described. It is also desirable that the nozzle be movable between a home or reference position and aiming position for each cutting tool then return to the home position as a preliminary to resetting for the next cutting tool in succession. Most desirably, the plunger assembly is also spring-loaded to compensate for excessive travel of the head.

Page 28, line 1 through page 30, line 4:

As further shown in Figures 12 to 16, the pivotal movement of nozzle 88 is regulated by a plunger assembly which includes the connecting rod 22 at the lower end of the assembly and which is mounted in a bore 10D extending vertically through the greater length of the housing 10 and terminates in a lower cavity 10B which receives the shaft 18. An overtravel function is provided in the plunger assembly by compression spring 26 disposed

in surrounding relation to a screw 28. The upper end of the screw 28 includes an enlarged head 28A seated in the bottom of a bore 30B in an elongated hollow piston 30, and the upper end of the spring 26 bears against lower end surface 30A of the piston 30 with the screw 28 extending downwardly through a bore in the ~~base 30A~~ piston 30. The spring 26 also bears against end surface 22B of the rod 22 so as to provide an opposing force to the opposite, lower end of the screw 28 which is threaded into the threaded hole 22C in the top of the connecting rod 22. Outer surface 30C of the piston 30 is slidable through the lower end 32A of a guide tube 32 which is pressfit into upper end 10D of the main plunger passageway.

The threaded bore 30B within the piston 30 receives and threadedly engages an outside threaded surface portion 34A of a plunger~~, or plunger~~ 34. The piston is surmounted by an end cap or shield 36 which threads onto the plunger 34 and rests on a top surface 30E of the piston 30. A jam nut 38 is threaded onto the plunger 34 until it bears against upper surface 36A, and the plunger end 40 is affixed using adhesive to the terminal end surface 30B of the plunger 34. The plunger end 40 is suitably composed of an elastomeric material which will minimize the noise produced when the plunger end 40 contacts the upper panel 82 of the machine center. The end cap 36 includes a downwardly extending skirt in surrounding relation to the upper end of the cylinder 32 and operates to keep foreign matter out of the plunger assembly as well as the entire apparatus. The plunger 34 is used to calibrate the nozzle apparatus by threaded adjustment through the piston 30 and then being locked in position by the jam nut 38. Thus, when the housing 10 is mounted on the sidewall of the head 80 and the

head 80 is moved to the highest possible position in its normal operating range, the plunger 34 is adjusted upwardly by threading it with respect to the shield 36 until the nozzle 84 is advanced to the clockwise limit position shown in Figure 14. The jam nut 38 is then tightened against the shield 36 to lock the plunger 34 in place.

Page 32 line 14 through page 33, line 12:

A fail-safe feature is provided in order to prevent damage to the machining center and nozzle apparatus in the event of accidental overtravel of the plunger beyond a programmed limit. Figure 16 is a sectional view of the nozzle apparatus 84 in its overtravel position as previously discussed in connection with Figure 12 but illustrating the compression of the spring 26 thereby permitting overtravel of the piston 30, the shield 36, the jam nut 38, plunger 34 and the plunger end 40. The lower end of the overtravel spring 26 bears against the top of connecting rod 22. The upper end of overtravel spring 26 seats against a spring base 30A of overtravel piston 30. The overtravel screw 28 threads into a threaded screw hole 22C in the top of connecting rod 22. A lower head surface ~~22A~~ 28A of the overtravel screw 28 ~~seats against~~ stands above the bottom of a screw bore 30B in overtravel piston 30, ~~providing an opposing force to the compressed~~ permitting compression of overtravel spring 26. The cylindrical outside surface 30C of overtravel piston 30 slides in a guide bore 32A in a guide cylinder 32. The guide cylinder 32 presses into a cylinder bore 10C in housing 10.

Page 37, line 6 through page 38, line 10:

Housing 210 serves to integrate the various components in nozzle apparatus 284. An inlet bushing 254, shown in Figure 21B, interfaces with a bore in the rear of housing 210 using a cylindrical snap fit. Valve 56 threads into the right end (rear) of inlet bushing 254. Coolant inlet 86 is located in the right end (rear) of valve 56. A coolant supply line (not shown) connects pressurized coolant to the coolant inlet 86. Inlet bushing 254 provides a sealed passage for pressurized cooling fluid between the non-rotating valve 56 and a rotating shaft assembly 218. The rear o-ring 253 shown in the inlet bushing 254 seals against the cooling fluid pressure. Drain port 254A in inlet bushing 254 serves to drain any cooling fluid that might get past rear ~~o-ring~~ O-ring 253. The front ~~o-ring~~ O-ring 253 shown in the inlet bushing 254 operates at ambient pressure and keeps contamination out of housing 210. Valve 56 allows the machining center operator to shut off coolant supplied to nozzle apparatus 284. The valve 56 is a conventional component, previously described in the discussion of Figure 11. The machining center 100 is also described in the discussion of Figure 11.

A nozzle-end bushing 255 interfaces with a bore in the front of housing 210 using a cylindrical snap fit. The purpose of the ~~o-ring~~ O-ring 253 in bushing 255 is to keep environmental contamination out of housing 210.

Page 40, line 19 through page 41, line 15:

An overtravel function is provided by an overtravel spring 26, an overtravel screw 28, an overtravel nut 229, and a piston 230. The lower end of overtravel spring 26 seats in a counterbore 22B in the top of connecting rod 22. The upper end of overtravel spring 26 seats against an overtravel spring base 230A of piston 230. An overtravel nut 229 threads partially up the overtravel screw and the overtravel screw 28 threads into a threaded screw hole 22C in the top of connecting rod 22. A lower head surface ~~22A~~ 28A of the overtravel screw 28 seats against the bottom of a screw head bore 230B in piston 230, providing an opposing force to the compressed overtravel spring 26. Piston shaft 230C of piston 230 slides in a piston bore 210D in housing 210. The lower end of a seal boot 232 fits over a housing boss 210L in housing 210. The upper end of a seal boot 232 fits over a piston boss 230E on piston 230. In the overtravel position (not shown), contact between piston 230 and housing 210 limits overtravel stroke.